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FEATURES OF ELECTROCHEMICAL CONCENTRATION OF NOBLE METALS ONTO NANOPOROUS ELECTRODE MATERIALS

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Introduction

High interest in gold is associated with various fields of application of this metal and its value as an asset in the financial market. Gold is the subject of numerous studies of electrochemical processes occurring at the surface of various materials. The purpose of this work is to study the anodic oxidation and cathodic reduction of gold ions using carbon-based materials, which were obtained by carbonization and activation of rice husk (RH).

Materials and Methods

The cleaned and dried RH was collected from local farms of Almaty region, Kazakhstan, and subjected for carbonization at 500^{o}C in the argon atmosphere. Carbonized RH was mixed with potassium hydroxide by use the weight proportion of 1:5 (precursor to KOH) and activated at 850^{o}C under argon atmosphere. The resulting mixture was subjected to washing by distilled water until the neutral pH.

For the study of the specific surface area, carbon materials from RH were used, which were examined for the analysis of the specific surface "Sorbtometer-M". Microstructural and elemental analysis was carried out using a Quantum 3D 200i Dual System SEM and a JEO JSM-6490LA scanning electron microscope. The electrochemical investigations were conducted by using potentiostat/galvanostat Elins P-40X.

Results and Discussion

A number of experiments were carried out on the synthesis of various porous carbon materials from local rice husk. The obtained materials were studied by modern and informative physico-chemical methods of analysis (scanning electron microscopy, Raman spectroscopy, EDAX analysis and surface area (BET) analysis), which demonstrated that obtained materials have a developed porous structure with high specific surface area.

Electrochemical behavior of gold (III) ions in an aqueous medium was studied by cyclic voltammetry (Figure 1(a-b)) using three different concentrations of gold (III) ions (1; 2.5 and 5 mg / l). Electrochemical deposition of gold (III) ions was carried out on the surface of carbon electrodes from electrolyte in the form of solid gold, followed by dissolving and recording of current-voltage curves at a potential window from -1.5 V to +1.5 V.

Chronoamperometric curves at a potential of -200 and -500 mV at various concentrations of gold (III) (pH = 1.39) against the background of 0.01 M HCl for the RH electrode are represented in Figure 2 (a-b). The SEM images clearly show that gold nanoparticles with particle sizes of ~ 100 nm were deposited on a sample of carbon material from rice husk (Figure 3 (a-b)).

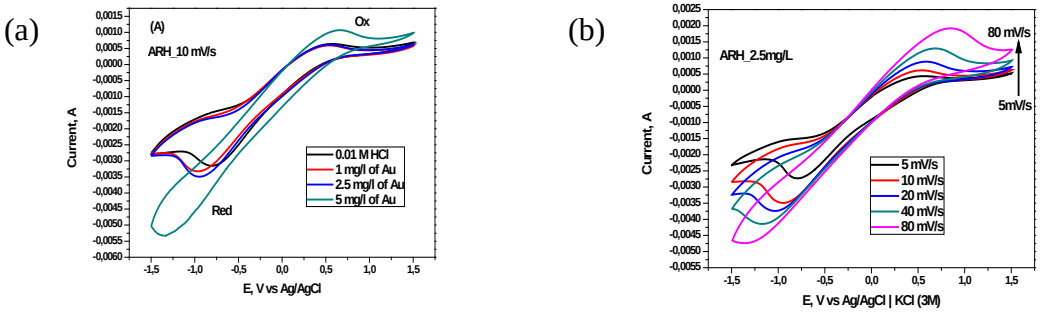

Figure 1. Cyclic voltammograms with different concentrations of gold (III) (a) and with different sweep speeds (b) in a solution of gold ions with a concentration of 2.5 mg / l (pH = 1.39) against the background of 0.01 M HCl for the RH electrode.

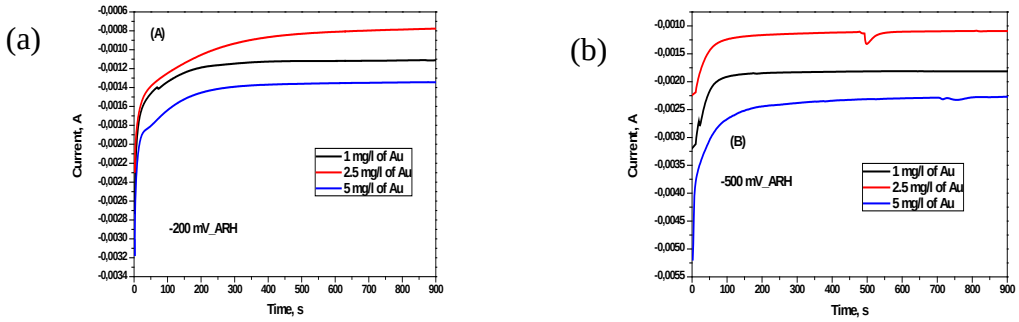

Figure 2. Chronoamperometric curves at a potential of -200 (a) and -500 mV (b) at various concentrations of gold (III) (pH = 1.39) against the background of 0.01 M HCl for the RH electrode.

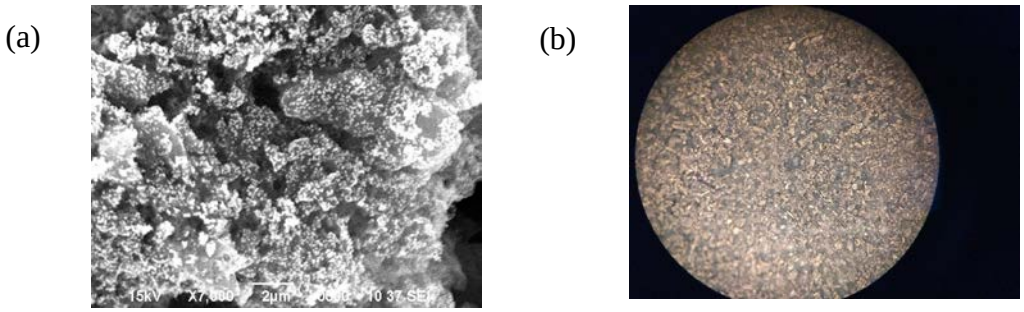

Figure 3. SEM (a) and optical (b) surface images of rice husk carbon electrode.

Conclusions

The concentration effect of model solutions of gold (III) containing from 1 to 5 mg/l at pH = 1.39 against the background of 0.01 M HCl on the deposition process was investigated. Optimal characteristics of porous active carbon from rice husk for gold sorption are determined.

Acknowledgment

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